STUDIES IN POTATO ROSETTE II.

PREVALENCE OF ROSETTE. METHODS OF PREVENTION.
ELIMINATION BY ROTATION.
TOMATO ROSETTE.

OHIO
Agricultural Experiment Station

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STUDIES IN POTATO ROSETTE II.

BY A. D. SELBY.

The writer has previously reported certain investigations of a parasitic disease of potatoes to which the name of "Rosette"* was applied. Despite the brief time that has elapsed since the issue of that publication, the widespread occurrence of the trouble in Ohio and elsewhere, and the interest manifested in the preventive measures recommended, seem to warrant the immediate publication of the investigations made during the season of 1903. Since these bear largely upon the matter of remedies for the rosette, the public is entitled to as early information regarding the results secured as the exigencies of preparation and publication may afford.

THE ROSETTE DISEASE CHARACTERIZED.

Potato rosette, as set forth in the earlier bulletin, is a disease of the vegetative portions—the growing parts—of the potato plant, which usually manifests itself in the more or less distinct clustering of the terminal leaves of the newer shoots; the actual points of

* A Rosette disease of potatoes attributed to the sterile fungus Rhizoctonia; Bulletin 139, Ohio Agricultural Experiment Station; Pp. 53-66 with five figures—April, 1903.

parasitic attack occur upon the underground stems of the potato plants or very near the soil level, if above it, and exhibit distinct rounded or elongated lesions. These lesions are found to result from the presence of the threads or hyphæ of a fungus referred to the sterile or non-spore-forming genus, *Rhizoctonia*; the evidence is clear that the fungous growth just mentioned may take rise from certain resting forms of the fungus present upon the seed tubers. This does not exclude other possible sources of infection, yet the seed treatment evidence supports very largely the seed source as that of usual infection. The leaf clustering or rosette formation is regarded as the secondary result of the parasitism of the fungus; it is not inconceivable that any considerable checking to the plant might result in similar manifestations of shortened leaf-bearing axes and petioles. Yet be this as it may, the observed rosettes have been accompanied by the lesions and fungus forms already mentioned. (See Fig. 1)

It has further been observed that the lesion injuries have been limited to the portions immediately surrounding the lesions. The bases and branches of the potato stems have in some instances been completely killed by the progress of the disease under the conditions of the present season. (See Fig. 2.) The consequences of the injury, of whatever degree, are to reduce the vigor and effectiveness of the vegetative parts of the plants. In proportion as the vigor is impaired and the functional activity reduced, the yields of the tubers will be diminished. That this diminution is very considerable, even under circumstances of what might be termed moderate attack, will appear from the tabulated results of the season's experiments, on pages 20-22.

If then the seed tubers are a source of infection it is clearly possible to destroy the attached fungus and remove the cause of disease, provided the soil is not infected in a similar manner. As with the well known potato scab, this fungicidal treatment of the seed tubers may be expected to succeed in proportion as the tuber is the sole source of the disease for the area in question. But as the fungus of the rosette is even more conspicuously a source of injury to the vegetative parts than the scab fungus, and much less a source of injury to the appearance of the tubers produced, too close analogy must not be assumed between the general results of seed treatment for the two maladies.

PREVALENCE OF ROSETTE IN OHIO, 1903.

The prevalence of rosette in early potatoes grown in Ohio the past season may be summed up as universal. Of the many early, or garden areas of potatoes visited by the writer, scarcely a single one was found that did not show the presence of the rosette trouble. In a number of such areas estimates or counts were made and these may be stated approximately as from 5 per cent. to 25 per cent. diseased; occasionally the proportion of diseased hills reached 40 per cent. of the whole. Such observations were made in several counties remote from each other, and have been confirmed by the voluntary statements of growers who studied exhibits of the disease made by this department at the Ohio State Fair, Columbus, and at the fairs of Stark and Wayne counties, held respectively at Canton and Wooster. Mr. G. M. Lummis, Assistant Botanist, made some interesting notes upon the occurrence of sclerotia of the fungus of rosette upon the potatoes exhibited and honored by premium awards at the two county fairs just named:

"Canton Fair: Of potatoes receiving first premium, in all twenty-nine plates, 76 per cent. showed rosette fungus on tubers and 48 per cent. showed scab."

"The varieties at Canton showing no rosette were Everett, Delaware, Cambridge Russett, Early Admiral Dewey, Uncle Sam and Pride of America."

"Wooster Fair: Of potatoes receiving first and second premiums (latter list not complete) ten plates, 60 per cent., showed rosette fungus and 100 per cent. had scab."

At Cheshire, Ohio, in a field where the Carman showed 12 to 14 per cent. of plants affected in 1902, the Early Fortune showed but 2 to 3 per cent. affected with rosette the present season. This was on soil that had grown previous crops of potatoes. On fresh soil with respect to potato crops, seed secured from a distant point yielded 10 per cent. of diseased plants.

Upon another farm near the same place the crop was observed to have 10 per cent. of the plants diseased; a particular specimen, gathered from this field, showed the lower extremity of the stem black and entirely dead (see Fig. 2)

Anyone who examines the tubers on the market, especially after moistening with water to increase color contrast between the fungus and the tuber, will be convinced of the general prevalence of this rosette fungus in our state.

ROSETTE AND EARLY BLIGHT. SPECIMEN DESIRED FOR 1904.

In some instances there has been an observed association of the rosette disease and early blight. It would not appear unnatura that plants with diseased stems should show early decline and death of the leaves. It is suggested that there is possibly a wider association of rosette and early dying and blighting of the leaves of the potatoes, with the usual marks of the disease known as the early blight, than has heretofore been noted or recorded. Observations in this connection promise to be of value to potato growers. There is no good reason why these observations may not be made by the growers themselves. I shall be pleased to receive reports of such observations for the season of 1904, from Ohio potato growers. It will be advisable also to send specimens of the leaves and the underground parts of the potato stems, commonly spoken of as the roots.

PLAN OF TREATMENT EXPERIMENTS IN 1903.

The experiments to be described, contemplated planting the crop on soil badly infested from a previous potato crop known to have been diseased, and on soil presumptively free from this infection. It is now apparent that the former condition was more clearly met than the latter.

The indicated success of formalin for rosette led to its use as the standard remedy; in comparison with formalin, sodium sulfid, lime, potassium sulfid and corrosive sublimate were employed; the three first named were applied to both soil and seed. Three varieties of potatoes were used for the work.

The treatment plots were placed in land under culture by the Horticultural Department of the Station, and to the cordial cöoperation of that department and especially to the aid of the Garden Foreman, Mr. J. L. Taggart, the writer is deeply indebted. To my own assistants, the late Mr. Jno. F. Hicks at planting time, and Mr. G. M. Lummis at harvest time, I am also indebted. The latter faithfully carried out the work of weighing the yield of tubers and the more tedious labor of separating the tubers bearing the marks of scab and of the rosette fungus and of determining their weight.

SCHEME OF PLOTS AND REMEDIES.

These may for descriptive purposes be divided into three tracts and five lots as follows:—

Tract A:—On soil in diseased potatoes in 1902.

Lot I—Variety, Early Trumbull. Treatment involves seed tubers with formalin and sodium sulfid also both these with lime on the soil.

Lot II—Variety, Early Trumbull. Treatment by formalin, sodium sulfid, potassium sulfid and lime on seed tubers only.

Lot III—Variety, Carman. Treatment, as in Lot II with addition of corrosive sublimate.

Lot IV—Variety, Enormous. Treatment as before.

Tract B:—On soil in part in tomatoes in 1902. Not know to be infected by the fungus

Lot V—Variety, Early Trumbull. Treatment on tubers as before.

Tract C:—Roadways in the regular 3-crop potato rotation. This land was clover sod in 1902 following wheat in 1901 and in potatoes in 1900. Probably still infected.

Lot VI—Variety, Early Trumbull in single row plots occupying the roadways of the standard plot plan.

RESULTS OF TREATMENT EXPERIMENTS.

The potatoes of tracts "A" and "B" were planted May 19, 1903, while those of tract "C" were planted May 16. The strength of formalin, forty per cent. formaldehyde employed for the treatment of the tubers was that recommended by Arthur* for scab; namely, 1 pound formalin to 30 gallons of water. In this solution the seed tubers were immersed for periods of 2, 3½ and 4½ hours; the first named being taken as the standard. The sodium sulfid employed was made by heating together in a suitable vessel of glass or metal for fifteen minutes, caustic soda and flowers of sulfur. This, for the caustic soda used was in the ratio of 1.75 parts caustic soda 86 per cent. Na OH to 1 part sulfur; this means 1¾ pounds or ounces of the caustic soda to 1 pound or ounce of sulfur. It was the aim to prepare the normal sulfid $Na_2 S$. The compound thus made was used in an aqueous solution of about .7 per cent. sodium sulfid. The commercial potassium sulfid on the market was employed in a solution of similar strength. For corrosive sublimate treatment the usual strength of 1 ounce to 16 gallons of water was employed; in this solution the tubers remained but one hour as against the two-hour immersion in the chief remedies employed.

* Bulletin 65, Indiana Experiment Station, 1897.

It will be observed that the badly diseased tubers of the Early Trumbull variety did not, with or without treatment, give satisfactory yields. The yields of the Carman and Enormous are scarcely more satisfactory. The outcome of the experiment is shown in Tables I and II which follow:

TABLE I—RESULTS OF TREATMENT FOR ROSETTE DISEASE OF POTATOES IN 1903.

Plot No.	TREATMENT	Stand	Actual yield	Calculated yield per acre	Showing rosette fungus on tubers	Scabby tubers	Average weight of tubers
		percent	pounds	bushels	percent	percent	ounces
	TRACT A—On soil in diseased potatoes in 1902. LOT 1—Variety, *Early Trumbull*, covered with sclerotia.						
Sec. A	Seed treated, Formalin 2 hours (1-6)						
1	Lime, 20 bushels per acre on soil	89	38.	86	93	40	1.71
2	" 40 " " " " "	91	47.5	107.4	.....	.....	.....
3	Nothing on soil.....	88	27.	61	86	41	1.35
4	Formalin, .25 per cent sol. on soil....	86	37.	83.6	74	17	1.55
5	Sodium sulfid solution on soil	90	40.	90.4	67	37	1.69
6	Nothing on soil.....	99	30.5	69	77	31	1.53
Sec. B	Seed untreated, (7-12)						
7	Lime, 20 bushels per acre on soil	64	15.5	34.8	81	27	1.40
8	" 40 " " " " "	83	17.5	39.6	83	13	1.23
9	Nothing on soil	59	12.25	27 8	88	27	1.29
10	Formalin, .25 per cent sol. on soil....	86	20.	45.2	86	14	1.13
11	Sodium sulfid solution on soil.....	76	13.5	30.5	90	5	1.26
12	Nothing on soil.....	71	10.5	23.7	83	4	.91
Sec. C	Seed treated, sod. sulfid, 2 hrs. (13-18)						
13	Lime, 20 bushels per acre on soil	100	20.	45.2	73	10	1.09
14	" 40 " " " " "	98	19.	43	56	21	1.00
15	Nothing on soil.....	100	17.	38.4	81	13	.93
16	Formalin, .25 per cent sol. on soil....	93	23.	52	83	8	1.02
17	Sodium sulfid solution on soil.....	100	23.	52	63	4	1.03
18	Nothing on soil.....	95	21.5	48.6	48	1	1.08
	LOT II—Variety, *Early Trumbull*, seed only treated as specified						
19	Untreated.....	98	22.5	51	96	.....	1.35
20	Formalin, 2 hours.....	100	26.5	60	87	9	1.61
21	" 4½ hours.....	94	26.5	60	52	2	1.43
22	Untreated.....	98	26.	58.7	92	2	1.26
23	Potassium sulfid, 2 hours.....	96	22.	50	48	9	.89
24	Formalin, 4½ hours.....	93	26.5	60	44	.....	1.30
25	Untreated.....	100	18.75	42.4	95	3	1.45
26	Formalin, 3½ hours.....	94	26.5	60	45	2	1.45
27	Potassium sulfid, 2½ hours	100	31.	70	56	1	1.10

TABLE I—Continued.

Plot No.	TREATMENT	Stand	Actual yield	Calculated yield per acre	Showing rosette fungus on tubers	Scabby tubers	Average weight of tubers
		percent	pounds	bushels	percent	percent	ounces
	LOT III—Variety, *Carman*. Seed only treated.						
28	Formalin—Seed cracked	96	57	128.8	35	1	2.96
29	Untreated " "	100	66.5	150.3	62	13	2 72
30	Formalin " "	94	57	128.8	39	1	2 87
31	Untreated " "	91	63.5	143.5	61	19	3.06
32	Formalin	98	70	158.2	78	4	3.50
33	Corrosive sublimate 1 hour	84	53	119.8	26	5	2.52
34	Untreated	96	61	137.6	64	5	2.88
35	Sodium sulfid	93	64	144.6	37	5	2.57
36	Lime on seed	100	60	135 6	51	7	3.11
37	Untreated	100	62	140 1	51	13	2.68
38	Formalin	85	48.5	109.6	33	1	2.33
39	Corrosive sublimate	89	59.5	134.5	33	3	2.27
40	Untreated	88	56.5	127.8	73	36	2.56
41	Sodium sulfid	95	64.5	145.8	72	2	2.32
42	Lime on seed	93	57.5	130	38	1	2.29
	LOT IV—Variety, *Enormous*. Treatment as before.						
43	Formalin	85	28.5	64.4	21	21	1.87
44	(*Carman Variety*)	90	57.25	(130)	(77)	(3)	(2.10)
45	Untreated	98	30	67.8	50	14	1.79
46	Sodium sulfid	95	30	67.8	36	9	1.71
47	Lime on seed	91	21.5	48.6	72	66	1.95
48	Untreated	78	17	38.4	44	19	1.22
	TRACT B—On soil in part in tomatoes in 1902. Not known to be infested with the fungus.						
	LOT V—Variety, *Early Trumbull*. Treatment as before.						
49	Formalin	86	23.75	59.7	87	10	1.33
50	Sodium sulfid	83	20	45.2	41	4	1.01
51	Untreated	78	15.5	34.8	81	3	.95
52	Potassium sulfid	80	23 5	53.6	57	11	1.02
53	Lime on seed	84	32.5	73 5	48	21	1.13
54	Untreated	69	10.25	23	78	1	.86
55	Formalin	90	26	58.7	65	10	1.14
56	Untreated	61	7.5	17	87	3	.89
57	Sodium sulfid	85	21.5	48.6	44	3	.95
	TRACT C—Roadways in regular potato rotation.						
	LOT VI—Variety, *Early Trumbull*.						
1	Formalin	Good	153	127.5	22	97	2.49
2	Untreated	"	116	96.7	47	98	1.81
3	Sodium sulfid	"	132.5	110	52	98	1.72
4	Untreated	"	71	59	46	95	1.61
5	Formalin	"	87.5	73	21	98	1.80
6	Untreated	"	74.5	62	67	98	1.52
7	Potassium sulfid	"	123	102.5	44	99	1.93
8	Untreated	"	71.5	59.6	78	98	1.88
9	Lime	"	127	106	10	99	2.14

TABLE II—SHOWING SUMMARY OF AVERAGES OF TABLE I.

Lot	VARIETY	TREATMENT	Average yield per acre	Average diseased tubers	Average weight of tubers	Increase + or decrease — of treated over untreated
			bushels	percent	ounces	bushels per acre
I A	Early Trumbull	Nothing	65	81.5	1.47	.....
I "	" "	Treated	91.8	77.7	1.65	26.8
I B	Early Trumbull	Nothing	25.7	85.5	1.1	.....
I "	" "	Treated	37.5	85	1.27	11.8
I C	Early Trumbull	Nothing	43.5	64.5	1	.....
I "	" "	Treated	48	69	1'33	4.5
II	Early Trumbull	Untreated	50.7	94	1.35	.....
"	" "	Formalin	60	56.7	1.44	9.3
"	" "	Potas. sulfid	60	52	1	9.3
III	Carman	Untreated	139.9	62	2.75	.....
"	"	Formalin	131.4	46	2.97	— 8.5
"	"	Cor. sub.	127.1	29.5	2.4	—12.3
"	"	Sod. sulfid	145.2	54.5	2.42	+ 5.1
"	"	Lime on seed	132.8	44.5	2.7	— 7.1
IV	Enormous	Untreated	53.1	47	1.5	+ 1.4
"	"	Treated	60.2	43	1.85	7.1
V	Early Trumbull	Untreated	24.9	82	.91	.....
"	" "	Formalin	56.2	76	1.23	31.3
"	" "	Sod. sulfid	46.9	42.5	1.03	22.
"	" "	Lime on seed	73.5	48	1.4	48.6
"	" "	Potas. sulfid	53.6	57	1.02	28.7
VI	Early Trumbull	Untreated	69	59.5	1.69	.....
"	" "	Formalin	100	21.7	2.15	31
"	" "	Sod. sulfid	110	52	1.72	41.
"	" "	Potas. sulfid	102.5	44	1.93	33.5
"	" "	Lime on seed	106	10	2.14	37

YIELDS OF TREATED AND UNTREATED PLOTS.

These are summarized in Table II, together with other features.

Considering first, Lot I of the Early Trumbull variety in Section A we note with seed treated, the average of two plots receiving nothing, is 65 bushels per acre and from treated plots, 91.8 bushels per acre.

In Section B, with seed untreated and with similar soil applications, but under conditions of soil less favorable to yields, the two nothing plots give 25.7 bushels per acre while the four treated plots yield an average of 37.5 bushels per acre.

In Section C, contrasted with this, where all seed was immersed two hours in sodium sulfid solution, the plots receiving nothing on the soil average 43.5 bushels per acre, while the treated plots give an average of 48 bushels per acre.

If we compare Section C with Section B, which is apparently entirely without objection, the treatment of the seed in Section C, even when nothing was applied to the soil, increased the yield over the corresponding plots of Section B from 25.7 to 43.5 bushels per acre, or 77 per cent. These increases would appear to be the obvious results of the treatment applied; in one case to the soil only. in the other case to both seed and soil except on nothing plots.

Lot II, Plots 19 to 27, where seed treatment alone was applied, gives for the untreated 50.7 bushels per acre average, for the formalin treatments 60 bushels per acre, and for the potassium sulfid treatment 60 bushels per acre, there being no apparent difference in the yield between the longer and shorter immersions with formalin While the longer immersion was slightly unfavorable to prompt sprouting of the tubers, this retardation was not injurious.

Here the seed treatment has, on the average, increased the yield a little more than 9 bushels per acre, or a little less than 18 per cent.

In Lot III, variety Carman, the untreated plots yield 139.9 bushels per acre while those treated with formalin give but 131.4 bushels per acre. The treatment with sodium sulfid gave 145.2 bushels per acre while those treated with corrosive sublimate yield but 127 bushels. Here there is a decrease in yield as between the treated and untreated plots excepting where sodium sulfid was used.

In Lot IV, variety Enormous, excluding Plot 44 planted in another variety, the untreated plots yield 53. bushels per acre; the treated plots yield somewhat higher, amounting on the average to 60.2 bushels per acre. It must be confessed in this connection that the appearance of the plots in this lot, especially during early growth, indicated a wider difference than the 14 per cent. increase of treated over untreated.

In Lot V, with the Early Trumbull variety again, the untreated plots yield but 25 bushels per acre; the formalin plots 56 bushels per acre; the sodium sulfid plots 47 bushels and the single plot treated with potassium sulfid gives 73.5 bushels and that with lime

sprinkled upon the seed yields 53.6 bushels per acre. Here we have on the whole an increase of more than 100 per cent.; all included 112 per cent. Considering those treated with formalin only, the increase is 126 per cent. Since it is this Lot V in which we have the more nearly average condition of soil uninfected by previous crops, the increase is entirely satisfactory, while the total yields, as before stated, are very unsatisfactory.

Tract C, on clover sod in three-crop rotation, shows also wide divergence between the treated and untreated. Where formalin was applied the average yield is 100 bushels per acre, while the untreated plots yield only 69.3 bushels per acre. The single plots in which the seed was treated with sodium and potassium sulfid respectively, show higher yields than the average of the formalin plots. This is accounted for, however, by the fact that in this tract Plot 5 was planted in a dead furrow and placed at the greatest possible disadvantage. The marked apparent difference in the tops of this row, compared with the two adjacent rows throughout the season, as well as yields obtained, show what formalin accomplished under these circumstances. It would be more just, therefore, when comparing the different substances employed, to institute comparisons between plots 1, 3, 7 and 9 singly. Eliminating then Plot 5, the average of the treated plots is 111.6 bushels per acre; of the untreated but 69 bushels per acre; an increrse in yield of 42.6 bushels per acre, or 61.7 per cent.

Summing up then the results as to increase of yield they are somewhat variable yet conspicuous where the tubers were planted upon badly infected soil, but strongly marked and decisive where planted upon soils without such previous, serious infection. It is not clear from these results that there is any very great difference between the efficiency of sodium sulfid and formalin as a means for treating the seed tubers; yet the simplicity of the formalin treatment in its actual application as compared with making the sodium sulfid is decidedly in favor of the formalin method.

It is not clear what cause lies behind the contradictory results with the Carman variety.

RESULTS AS TO PROPORTION OF DISEASED AND SIZE OF TUBERS.

These results are also given in Table II. The differences are not striking in Lot I, there being no distinct change as between the treated and untreated areas with respect to percentage of tubers showing the fungus of rosette upon them.

Upon Lot II we have striking differences; the untreated plots show 94 per cent. of diseased tubers against 56.7 per cent. on those treated with formalin and 52 per cent. where potassium sulfid was employed.

Lot III gives also a marked contrast, the untreated tubers showing 62 per cent. diseased, formalin treated 46 per cent. with other treatments somewhat diverging but all more favorable than untreated

In Lot IV the untreated show 47 per cent. against 43 per cent. diseased in the treated, while in Lot V we get 82 per cent. diseased in untreated, 76 per cent. in those treated with formalin, 42.5 per cent. and 57 per cent. in those treated with potassium sulfid and sodium sulfid respectively; while the application of lime on the seed gives 48 per cent. of diseased tubers.

In Lot VI the untreated plots show nearly 60 per cent. of rosette diseased tubers against 21 per cent. with formalin treatment and only 10 per cent. with lime. Evidently the freer the soil is from infection the more complete the immunity to be secured by treatment. If we refer to the amount of scab (Table I) the unfavorably high percentage of scab infected tubers bears conclusive evidence of persistent soil infection by scab despite the three-crop rotation.

As to size of tubers, as will be observed by the table, all of the sections of Lot I give increased size with the soil-treated plots. In Lot II the formalin-treated only are larger, having an average weight of 1.44 ounces against 1.35 ounces in the untreated. The larger potatoes in the Carman variety show less satisfactory results with respect to treatment, the untreated having an average of 2.75 ounces, the formalin-treated 2.97 ounces, while the other treatments yield smaller tubers than the untreated.

In Lot IV, the Enormous variety, the average weight of untreated tubers is 1.5 ounces, against 1.85 ounces in the treated; and in Lot V the untreated average .90 ounces, with formalin 1.23 ounces, with lime on seed, 1.4 ounces; while with sodium sulfid and potassium sulfid they are smaller.

Lot VI shows even larger tubers than the others of the same variety (Early Trumbull). The untreated plots give an average of 1.69 ounces; the formalin treated, 2.15 ounces and all the others are larger than the untreated as will be seen by reference to the table. As in the matter of yield Plot V, as treated with formalin, may better be set aside; in that event the average tuber weight of Plot I, 2.49 ounces, will show a more decisive contrast.

ELIMINATION OF ROSETTE FUNGUS BY ROTATION.

It has become apparent that the three-crop rotation of potatoes, wheat and clover. as followed by the Station, does not appear to eliminate all of this fungus from the soil; it may prove that even a longer rotation may not do so. In order to discover, if possible, what proportion of the clover plants are attacked by rhizoctonia, a student assistant in the department, Mr. True Houser, removed a considerable number of clover plants from the various plots where clover was grown in 1903, having been seeded in wheat following potatoes. Here and there a large proportion of the plants were found affected by the fungus in question, and the inference is drawn that the fungus remains in the soil under the conditions just stated. These plots have received phosphatic fertilizers chiefly, a few manured plots among them may yield more decisive comparisons in future examinations. We are convinced, however, from the recurrence of the rosette disease in the potato plots in the three-crop potato rotation, that a longer rotation is desirable and almost necessary, if we keep in mind solely the elimination of the rosette disease in soils frequently devoted to potato growing. The results as to scab are equally impressive. A tilled crop suggests itself as against sod. Some other practical suggestions, however, stand in the way of the adoption of such rotation.

TOMATO ROSETTE.

Some indications were obtained in 1902 that tomatoes are attacked in a manner similar to potatoes. The allied nature of the tomato plant led us to expect such a result, which has been observed by several examinations the present season. Early in the season, Mr. Lummis was called to a garden lot in Wooster, where part of the tomato plants were exhibiting diseased characteristics. Here he found similar conditions of the tomato tops to those observed with potatoes, namely, the peculiar leaf aspects. Later on the writer made studies of the tomato plants within the tomato plots of the Station garden, which were located on soil in which diseased potatoes had been grown in 1902. While the varieties did not exhibit the same amount of infection, several varieties did show very strongly marked characteristics. I have designated this aspect as "tomato rosette" while "tomato slims" might be more expressive. The tips of diseased plants show rather long internodes and dwarfed leaves with somewhat curled leaf aspects. The root conditions show lesions and other similar features to those found in potato rosette plants. Unfortunately a call elsewhere at the time when photographs

should have been made prevented this being done and no illustrations can be offered. Quite a decrease in productiveness was noticed in connection with these diseased plants.

This note is necessary to point out some of the bearings of the rosette question upon the character of crop to be planted following potatoes. It is hoped to give this disease of tomatoes further study in the coming season and to conduct certain experiments under glass during the forcing house season.*

SUMMARY.

This bulletin is concerned with further investigations of a rosette disease effecting the vegetative portions of the potato, attributed to the sterile fungus Rhizoctonia, and especially with the results of experiments in the prevention of this disease.

Studies have been made to ascertain the prevalence of the rosette; these disclose the widespread occurence of the disease throughout Ohio in 1903. The prevalence for the state may be regarded as universal.

Since this disease affects the vegetative parts by attacking the stems, it is accompanied by leaf injury. The leaf impairment is such as to suggest that much of the trouble with us heretofore known as early blight may be associated with these rosette injuries. Specimens and reports along this line are desired for the season of 1904.

Experiments made during the season of 1903, in cöoperation with the Horticultural Department of the Station, show that treatment of the seed tubers with formalin and sodium sulfid by an immersion of two hours before planting, has yielded profitable returns: the same has been true of treatment with potassium sulfid, and lime.

*A ROSETTE DISEASE OF LETTUCE—My attention has been called to a condition in forcing house lettuce answering very well to the designation "rosette." The plants affected show, usually, not long after transplanting, but occasionally at other stages, a failure to send out central leaves freely. The leaf-bearing axis remains shortened, and the last leaves formed remain short, making a very striking contrast to the remainder of the plants in the bed and to the lower leaves of the same plant. Frequently the plants overcome this tendency and make a fair amount of product with longer time. Examination of the roots shows areas occupied by the hyphae of rhizoctonia. The analogy in symptoms exhibited to those described for potatoes is so striking that almost anyone who has studied the potato trouble would designate this "rosette in lettuce". The explanation of the recovery doubtless lies in the production of new roots under the recurrent stimuli of abundant moisture and necessary high temperature which are supplied under greenhouse conditions, and in a sense, the outgrowth of the attack. The source of the fungus is doubtless to be looked for in the manure supply worked into the soil, and the remedy for the condition likewise is to be sought in the complete sterilization of the manured soil by steam, as for "drop," nematodes and other troubles. Methods for this treatment are set forth in Bulletin 73.

This profitable return has been secured in soil previously infected by the fungus of the disease but has been found nearly twice as great when applied to seed tubers planted in soil free from disease. In the latter case the increase in yield has been as high as 125 per cent. upon a light crop of the Early Trumbull variety.

The treatment has had the effect to increase the average size of the tubers harvested. It has also reduced the proportion of the crop having the fungus upon the tubers.

It is recommended that *seed potatoes be treated before planting by immersion for 2 hours in a solution of formalin containiug 1 pound of formalin in 30 gallons of water*, since this is an efficient means of rosette prevention and one easily applied.

Sodium sulfid and potassium sulfid are promising remedies worthy of further trial especially since the former may be prepared at such small cost. As yet neither of these has been tested for sufficient time to recommend for general use.

An analogous disease of tomatoes has been studied and designated as "tomato rosette." A similar rosette disease of forcing house lettuce is being studied.

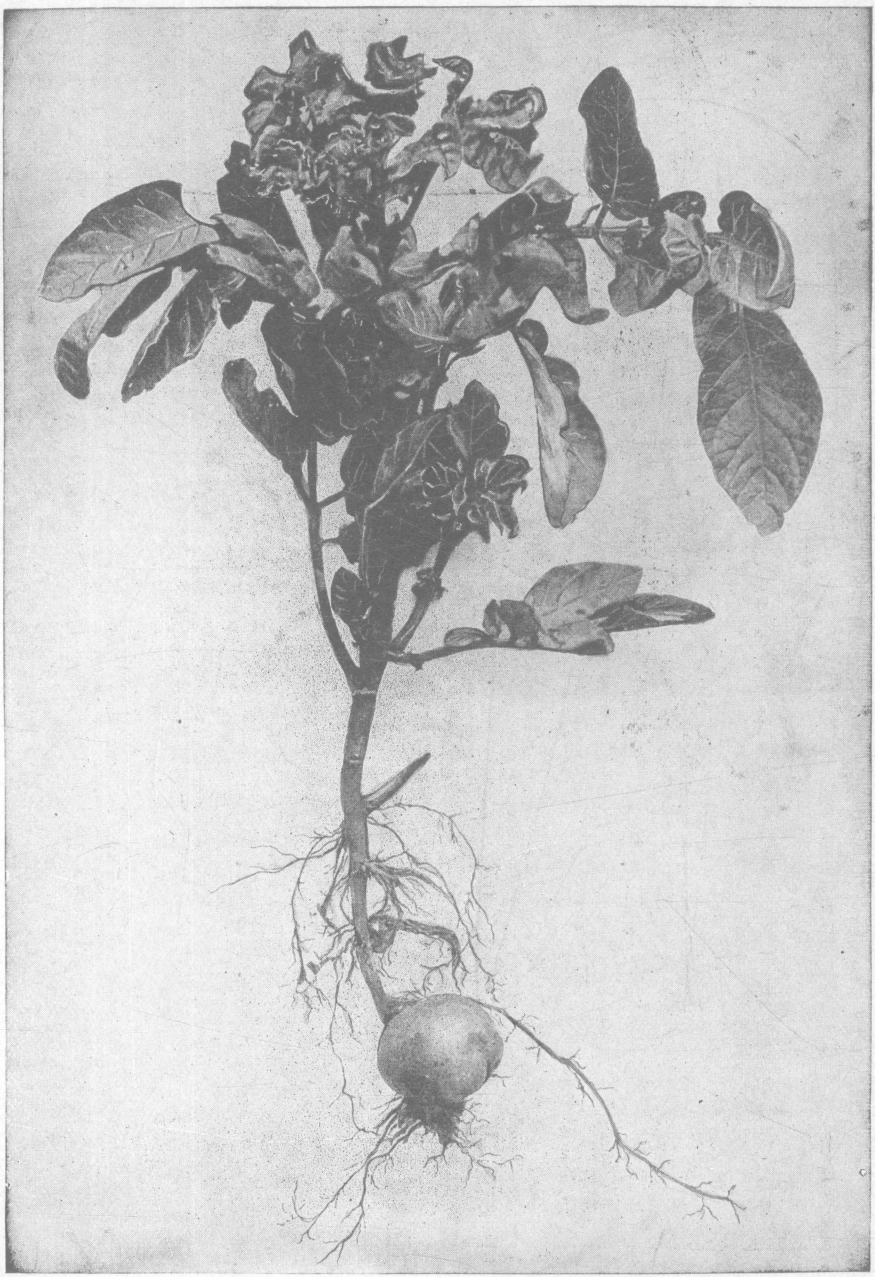

FIGURE 1—Plant of the Early Fortune variety with characteristic rosette aspect and with lesions on stem. (Cheshire, Ohio, June 27, 1903.)
From a photograph by Gillmore, Galipolis, Ohio.

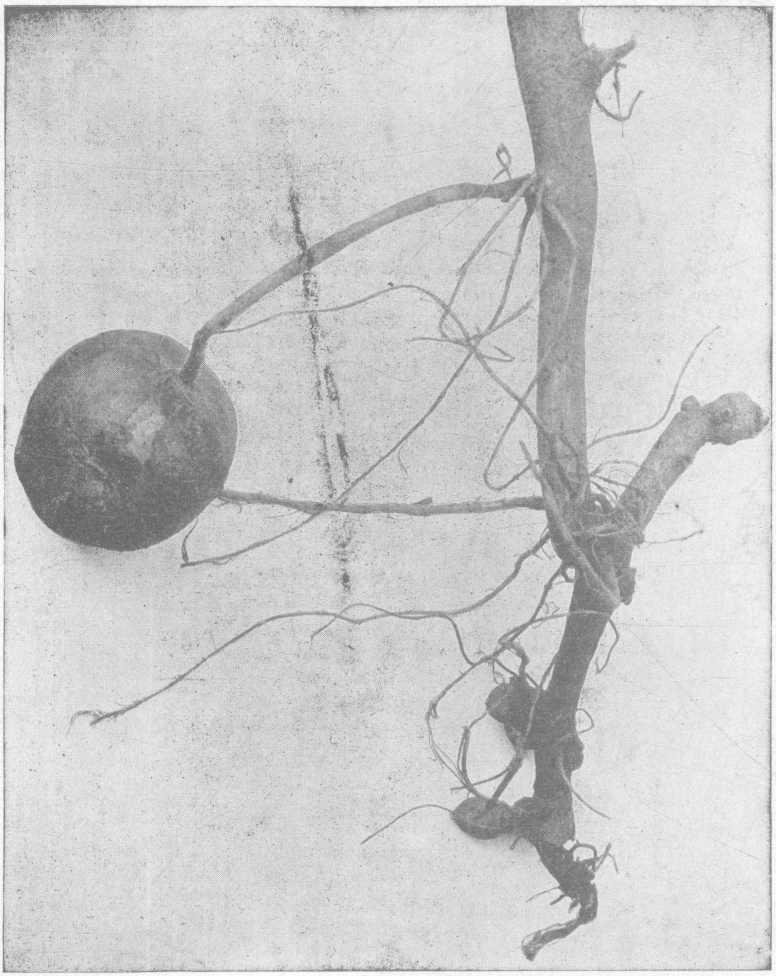

FIGURE 2—Base of potato stem of an early variety, (Cheshire, Ohio, June 27, 1903) showing few tubers and stem, black and dead below forking, killed by disease; the branchlet bearing the ruber is nearly destroyed by a lesion located near the tuber. The leaves of this stem showed strongly marked rosette. *From a photograph.*

FIGURE 3—Seed potatoes of Early Trumbull variety showing the numerous rounded sclerotia as dark areas.—*From a photograph by W. H. Kramer.*

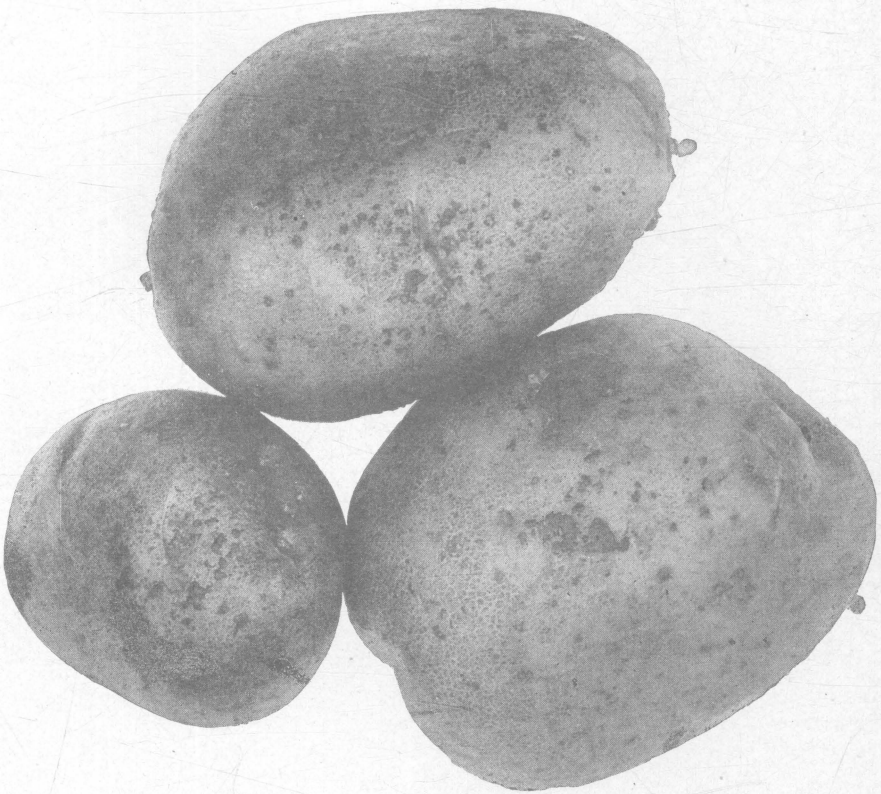

FIGURE 4—Some of the tubers of the crop marked by rosette sclerotia and hyphæ and by scab.—*From a photograph by G. M. Lummis.*